

Appl. No. : **10/797,888**
Filed : **March 9, 2004**

AMENDMENTS TO THE CLAIMS

1. (Currently amended) A method for selective removal of a high-k material from a substrate, the method comprising:

providing a high-k material on a semiconductor substrate; and
contacting the high-k material with a solution comprising HF at a concentration of from about 0.05 M, an organic compound ethanol at a concentration of about 80%, and an inorganic acid other than HF HCl at a concentration of about 20%, whereby the high-k material is selectively removed from the substrate.

2. (Original) The method according to claim 1, wherein the high-k material has a dielectric constant of greater than or equal to about 7.

3. (Original) The method according to claim 1, wherein the high-k material is selected from the group consisting of ZrO₂, Al₂O₃, HfO₂, Zr_{1-x}Al_xO_y, HfSiO_x, HfAlO_x, HfSiO_xN, and combinations thereof, wherein x is an integer, and wherein y is an integer.

4-10. (Canceled)

11. (Currently amended) The method according to claim 1, wherein a wettability of the organic compound ethanol for the high-k material is higher than a wettability of the organic compound ethanol for silicon oxide.

12-16. (Canceled)

17. (Original) The method according to claim 1, wherein a temperature of the solution is from about 20°C to about 80°C.

18. (Original) The method according to claim 1, wherein a temperature of the solution is about 40°C.

19-20. (Canceled)

21. (Original) The method according to claim 1, wherein the solution further comprises a surfactant.

22. (Original) The method according to claim 1, wherein the solution has a pH of from about -0.5 to about 2.

23. (Currently amended) A method for selective removal of a high-k material from a semiconductor substrate comprising:

providing a high-k material on a semiconductor substrate;

subjecting the high-k material to damaging, whereby a damaged high-k material is obtained; and thereafter

contacting the damaged high-k material with a solution comprising HF at a concentration of from about 0.05 M, an organic compound ethanol at a concentration of about 80%, and an inorganic acid other than HF HCl at a concentration of about 20%, whereby the high-k material is selectively removed from the substrate.

24. (Original) The method according to claim 23, wherein the high-k material has a dielectric constant of greater than or equal to about 7.

25. (Original) The method according to claim 23, wherein the high-k material is selected from the group consisting of ZrO₂, Al₂O₃, HfO₂, Zr_{1-x}Al_xO_y, HfSiO_x, HfAlO_x, HfSiO_xN, and combinations thereof, wherein x is an integer, and wherein y is an integer.

26-32. (Canceled)

33. (Currently amended) The method according to claim 23, wherein a wettability of the organic compound ethanol for the high-k material is higher than a wettability of the organic compound ethanol for silicon oxide.

34-38. (Canceled)

39. (Original) The method according to claim 23, wherein a temperature of the solution is from about 20°C to about 80°C.

40. (Original) The method according to claim 23, wherein a temperature of the solution is about 40°C.

41-42. (Canceled)

43. (Original) The method according to claim 23, wherein the solution further comprises a surfactant.

44. (Original) The method according to claim 23, wherein the solution has a pH of from about -0.5 to about 2.

45. (Original) The method according to claim 23, wherein the damaging comprises chemical damaging.

46. (Original) The method according to claim 23, wherein the damaging comprises physical damaging.

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47. (New) A method for selective removal of a high-k material from a substrate, the method comprising:

providing a high-k material on a semiconductor substrate; and
contacting the high-k material with a solution comprising HF at a concentration of from about 0.04 M to about 0.06 M, an alcohol at a concentration greater than or equal to about 50%, and HCl at a concentration of from about 10% to about 30%, whereby the high-k material is selectively removed from the substrate.

48. (New) The method according to claim 47, wherein the high-k material has a dielectric constant of greater than or equal to about 7.

49. (New) The method according to claim 47, wherein the high-k material is selected from the group consisting of ZrO₂, Al₂O₃, HfO₂, Zr_{1-x}Al_xO_y, HfSiO_x, HfAlO_x, HfSiO_xN, and combinations thereof, wherein x is an integer, and wherein y is an integer.

50. (New) The method according to claim 47, wherein a concentration of HF in the solution is about 0.05 M.

51. (New) The method according to claim 47, wherein a concentration of the HCl in the solution is from about 10% to about 30%.

52. (New) The method according to claim 47, wherein a concentration of the HCl in the solution is about 20%

53. (New) The method according to claim 47, wherein a wettability of the alcohol for the high-k material is higher than a wettability of the alcohol for silicon oxide.

54. (New) The method according to claim 47, wherein the alcohol is selected from the group consisting of ethanol, isopropylalcohol, ethyleneglycol, and mixtures thereof.

55. (New) The method according to claim 47, wherein a concentration of the alcohol in the solution is from about 60% to about 90%.

56. (New) The method according to claim 47, wherein a concentration of the alcohol in the solution is about 80%.

57. (New) The method according to claim 47, wherein a temperature of the solution is from about 20°C to about 80°C.

58. (New) The method according to claim 47, wherein a temperature of the solution is about 40°C.

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59. (New) The method according to claim 47, wherein the alcohol is ethanol.
60. (New) The method according to claim 47, wherein the solution further comprises a surfactant.
61. (New) The method according to claim 47, wherein the solution has a pH of from about -0.5 to about 2.
62. (New) A method for selective removal of a high-k material from a semiconductor substrate comprising:
 - providing a high-k material on a semiconductor substrate;
 - subjecting the high-k material to damaging, whereby a damaged high-k material is obtained; and thereafter
 - contacting the damaged high-k material with a solution comprising HF at a concentration of from about 0.04 M to about 0.06 M, an alcohol at a concentration greater than or equal to about 50%, and HCl at a concentration of from about 10% to about 30%, whereby the high-k material is selectively removed from the substrate.
63. (New) The method according to claim 62, wherein the high-k material has a dielectric constant of greater than or equal to about 7.
64. (New) The method according to claim 62, wherein the high-k material is selected from the group consisting of ZrO₂, Al₂O₃, HfO₂, Zr_{1-x}Al_xO_y, HfSiO_x, HfAlO_x, HfSiO_xN, and combinations thereof, wherein x is an integer, and wherein y is an integer.
65. (New) The method according to claim 62, wherein a concentration of HF in the solution is about 0.05 M.
66. (New) The method according to claim 62, wherein a concentration of the HCl in the solution is from about 10% to about 30%.
67. (New) The method according to claim 62, wherein a concentration of the HCl in the solution is about 20%
68. (New) The method according to claim 62, wherein a wettability of the alcohol for the high-k material is higher than a wettability of the alcohol for silicon oxide.
69. (New) The method according to claim 62, wherein the organic compound is selected from the group consisting of ethanol, isopropylalcohol, ethyleneglycol, and mixtures thereof.

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70. (New) The method according to claim 62, wherein a concentration of the alcohol in the solution is from about 60% to about 90%.

71. (New) The method according to claim 62, wherein a concentration of the alcohol in the solution is about 80%.

72. (New) The method according to claim 62, wherein a temperature of the solution is from about 20°C to about 80°C.

73. (New) The method according to claim 62, wherein a temperature of the solution is about 40°C.

74. (New) The method according to claim 62, wherein the alcohol is ethanol.

75. (New) The method according to claim 62, wherein the solution further comprises a surfactant.

76. (New) The method according to claim 62, wherein the solution has a pH of from about -0.5 to about 2.

77. (New) The method according to claim 62, wherein the damaging comprises chemical damaging.

78. (New) The method according to claim 62, wherein the damaging comprises physical damaging.